

## SURVIVORSHIP IN THE TUFTED TITMOUSE

WILLIAM H. ELDER

Most authors consider the Tufted Titmouse (*Parus bicolor*) a permanent resident species, but Van Tyne (1948) and Wilford (1977) distinguished transient and resident members of their banded populations of Tufted Titmice, and Condee (1978), using a moving trap-grid, found that so-called transients may have simply moved to an adjacent winter range to settle for breeding.

Compared with the Black-capped Chickadee (*P. atricapillus*) (Elder and Zimmerman 1983), there seem to be few published records of longevity in North American titmice and no studies of their population dynamics. A maximum longevity of 13 years 3 months was reported from a sample of 4460 recoveries received by USFWS (Clapp et al. 1983). The present analysis of 15 years of observations at a feeding and banding station was undertaken with the following objectives: (1) to use sightings of color-banded birds to estimate survival rates, (2) to compare these with estimates based on USFWS band recovery information, (3) to record maximum longevity and year-to-year site fidelity, and (4) to discern whether or not the species is migratory.

### MATERIALS AND METHODS

The study was conducted at my residence near the city limits of Columbia, Missouri, where observations were recorded nearly every day for 15 years, 1965-1979. Sunflower seed was provided on a feeding shelf at a second-story level 4 m above ground level, and birds were watched for an hour after seed was put out in early morning and at noon.

When an unbanded bird was sighted, food was restricted the next weekend, and Potter (Lincoln 1929) or McCamey (McCamey 1961) traps were set. All trapped birds received a USFWS aluminum band on one leg and colored plastic bands (red, orange, yellow, green, blue, black, and white) on the other. After all the possible combinations had been used, an additional color band was used above the aluminum band to provide another series. No loss of color bands was found during the entire 15-year period.

Birds were observed daily, but the presence of each was tabulated on a weekly basis. New birds were caught usually within a few days; recaptures were recorded to permit analysis of trapability and frequency of repeated captures. Birds were not weighed, measured, or sexed. In summer, HY (hatch year) birds can be distinguished by mouth color (Wood 1969), but so few birds were present or trapable at this time that the numbers were not sufficient to be treated as a separate cohort for analysis. Most trapping was accomplished from September until birds dispersed in April.

At the end of 15 years, data were analyzed with the Statistical Analysis System (Helwig and Council 1979) for survival, trapability, seasonal presence, and consistency among years.

Banding and recovery data for the entire range of the species were supplied by the USFWS Bird Banding Laboratory, and data from 1959-1979 were analyzed for survival and movement.

## RESULTS AND DISCUSSION

I banded 258 Tufted Titmice; of these, 238 were resighted or retrapped. There was no evidence of migratory movement; birds seen only once were taken in each month of the year. Twenty birds were never seen again after being retrapped once; their dates of arrival were scattered from August to March.

*Arrival and departure.*—New birds were trapped in every week from August through March but most frequently in November (28% of the total). A few birds were retrapped the next day but mean time to recapture was 3.8 weeks (SD = 4.7, N = 160). Only 20% of December arrivals stayed through January; 33% of January arrivals stayed through February. Local movement and concentrations at feeders were often associated with storms or prolonged cold. On the average, birds remained and were seen regularly for 18 weeks (SD = 9.6, N = 508). The length of their stay did not change with age. The mean span of time birds were absent before being seen again at the feeder was about 4 weeks; most absences were much shorter, but one bird stayed away for 26 weeks before returning the same year.

*Trapability.*—Birds were retrapped from 1 to 24 times in any one year, but 103 (43%) titmice were recaptured only once per year. One titmouse was captured 56 times during 5 years.

Sixty-two percent of the 258 titmice banded were retrapped and 92% were resighted. This difference is a measure of the frequency with which many birds enter traps to feed but escape without being caught. Many individuals became very proficient at hopping over the trap treadle without tripping the trap or flew so quickly that they escaped while the trap door was dropping.

*Site-fidelity.*—During 632 bird-years, 49 birds (7%) were missing for a year or more but returned in a later year. Forty of the absences were for 1 year, 4 for 2 years, 2 for 3 years, 2 for 4 years, and 1 for 5 years. Of 112 titmice observed in 3 or more years (thus making a skip possible), 29 (27%) skipped a year or more. This has also been reported for the Black-capped Chickadee (Elder and Zimmerman 1983) and the Great Tit (*P. major*) (Kluijver 1951).

*Longevity.*—The longest published record for Tufted Titmouse longevity is 13 years (Clapp et al. 1983). In my sample of 258, one bird lived to be 10 or more years old (Table 1). Although age at banding was unknown, I assumed that most birds were banded during their first winter (HY and AHY [after hatch year]). In my population, 28 birds (12%) were seen for 5 years, the same percentage that we found for the Black-capped Chickadee (Elder and Zimmerman 1983). In the large sample of titmice (N = 4460) from USFWS files, only 0.54% of recoveries exceeded 5 years

TABLE 1  
 MAXIMUM LONGEVITY RECORDS REPORTED FOR TUFTED TITMICE

Authority	Region	Number of birds	Oldest bird (years)
Brackbill (1970)	Maryland	130	6
Blake (1949)	Pennsylvania	Not given	7
Clapp et al. (1983)	Throughout species range	81,727	13
Condee (1969)	Pennsylvania	70	3
Laskey (1957)	Tennessee	327	6
Middleton (1969)	Pennsylvania	Not given	8 <sup>a</sup>
Short (1933)	Michigan	5	5
Van Tyne (1948)	Michigan	29	5
This study	Missouri	258	10

<sup>a</sup> Cited erroneously as 12 years by Kennard (1975).

of age. Recovery data do not seem to provide a realistic estimate of survival in nonhunted species.

*Influence of age.*—Statistical study of changes occurring with age of my titmice revealed that (1) older birds tended to arrive at the feeder earlier in the fall than did younger birds (slope =  $-1.03$ ,  $r = 0.20$ ,  $N = 632$ ,  $P = 0.0001$ ); (2) older birds departed earlier in the spring ( $r = 0.95$ ,  $N = 508$ ,  $P = 0.03$ ); (3) the number of times a bird was sighted did not change with age ( $r = 0.026$ ,  $N = 505$ ,  $P = 0.55$ ); (4) the weeks a bird absented itself from the feeder did not change with age ( $r = 0.014$ ,  $N = 505$ ,  $P = 0.77$ ); (5) the time elapsed from first capture each year until a bird was recaptured increased significantly with age (slope =  $0.63$ ,  $r = 0.248$ ,  $N = 180$ ,  $P = 0.0008$ ); and (6) the number of times a titmouse was trapped each year was negatively correlated with age ( $r = 0.114$ ,  $N = 685$ ,  $P = 0.05$ ).

Thus I conclude that Tufted Titmice visited the feeding station with fairly constant frequency throughout life but were trapped less frequently as they grew older and that arrival in fall and departure in spring occurred earlier with age and experience.

*Survival and mortality.*—A composite dynamic life table (Deevey 1947, Hickey 1952) was constructed from resighting data for all cohorts through 1979 (Table 2). From this a mean annual survival rate of 62% was calculated (Caughley 1977:105). Using equation 6a of Farner (1949) a mean life span of 2.1 years was determined—as compared to 2.4 years for our Black-capped Chickadee sample of similar size (Elder and Zimmerman 1983).

TABLE 2  
LIFE TABLES FOR THE TUFTED TITMOUSE AT COLUMBIA, MISSOURI, DERIVED FROM  
RESIGHTING AND RETRAPPING 258 BANDED BIRDS

$x^a$	Resighting data				Retrap data			
	$l_x$	$d_x$	$q_x$	$p_x$	$l_x$	$d_x$	$q_x$	$p_x$
0-1	230	94	0.41	0.59	230	163	0.71	0.29
1-2	136	34	0.25	0.75	67	31	0.46	0.54
2-3	102	47	0.46	0.54	36	16	0.44	0.56
3-4	55	20	0.36	0.63	20	8	0.40	0.60
4-5	35	16	0.46	0.54	12	3	0.25	0.75
5-6	19	6	0.32	0.68	9	5	0.56	0.45
6-7	13	6	0.46	0.54	4	2	0.50	0.50
7-8	7	0	0.00	1.00	2	1	0.50	0.50
8-9	7	6	0.86	0.14	1	1	1.00	0.00
9-10	1	1	1.00	0.00				

<sup>a</sup>  $x$  = age in years;  $l_x$  = survivorship to age  $x$ ;  $d_x$  = number of deaths during age  $x$ ;  $q_x$  = mortality during age  $x$ ;  $p_x$  = survivorship during age  $x$ .

When the same procedures were used to analyze recapture data, the survival rate was lower (40%) than determined from resightings, and the mean life span was only 1.17 years. This difference would be expected because many older individuals entered the traps but avoided recapture.

Recovery data from the USFWS banding files include a total of 67,859 bandings nationwide over 60 years (1922-1981), with 4460 recoveries for a mean recovery rate of 6.5%. From a total of 60,056 bandings from 25 years (1955-1979), 1435 recoveries and recaptures have been recorded. From these data a life table was constructed and analyzed in the same way as were the Missouri data cited above. This showed a mean life span of 0.93 years and a mean annual survival rate of 0.30.

Because the numbers of recoveries were so few and inconsistent from year to year, use of the Brownie model (Brownie et al. 1979) did not prove feasible. Therefore, I constructed a table that depicts the life span shown by each banding year cohort based on recoveries and recaptures (Table 3). The rapid decline in the frequency of observations after 1960 can be accounted for mainly by the change in the reporting procedures requested by the Banding Office. Banders were no longer required to report repeats of birds recaptured at the home banding station or in the same 1-min block where banded. The effects of this change in policy are shown in Fig. 1, which depicts the very low rate of recoveries during the past two decades despite an increase in numbers of Tufted Titmice banded during the period.

When recapture and recovery data from the USFWS files were separated



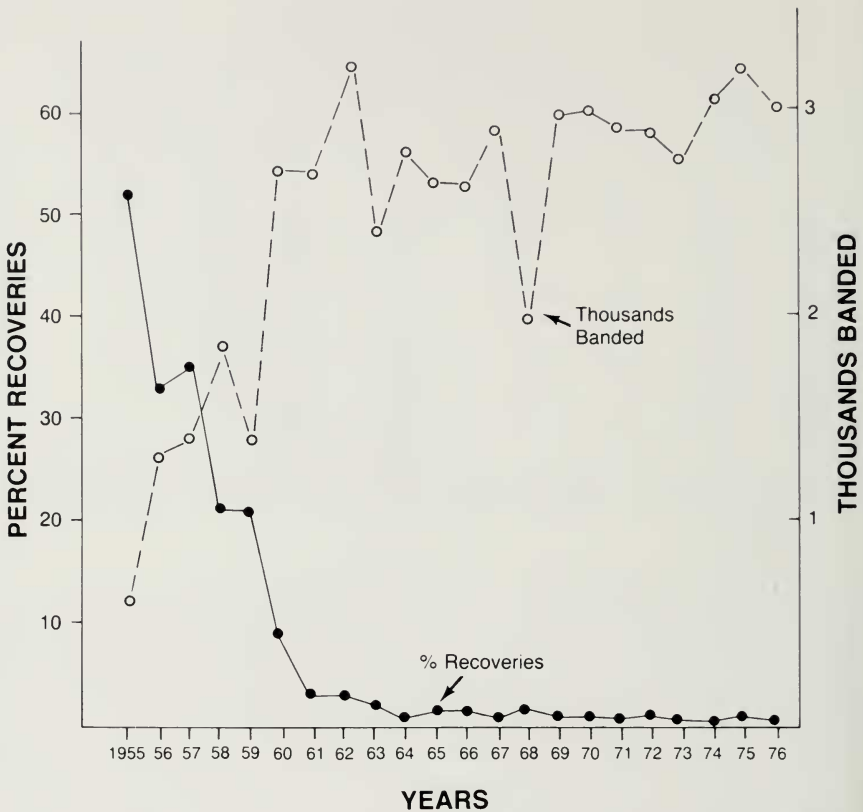


FIG. 1. Tufted Titmouse banding and recovery records from USFWS. Retrap data included only for the period available, 1955-59.

and life tables constructed for each, the calculated life span was 1.26 years for the birds recovered (dead) and 0.93 years for the birds recaptured (alive). The bias in calculating life expectancy from recaptures of live birds that have not lived out their life spans has been discussed by Hickey (1952) and Franks (1975).

The important conclusion is that careful observation and recording of a marked population of nonmigratory birds give much more realistic estimates of survival and mortality rates than does any combination of retraps and recoveries.

*Movement.*—Analysis of movement as shown by distance between banding station and recovery point for the 4460 birds with recovery records in the USFWS banding files showed that 40 titmice (<1%) had moved beyond the 10-min block where banded, and only 14 birds had

moved beyond 1° latitude or longitude. This clearly shows that Condee (1978) was correct in his conclusion that there is no migration in this species. The 27% of our Missouri-banded birds that were not seen for a year or more may have been only a few km away nesting or wintering.

#### SUMMARY

Survivorship among 258 Tufted Titmice (*Parus bicolor*) was studied by trapping, color banding, and weekly recording of sightings for 15 years at a feeder in Columbia, Missouri, from 1965 to 1979. Most birds avoided traps for a month after initial capture. Much local movement was indicated, as 80% of the December arrivals were absent in January and 67% of January arrivals were absent in February. Average residency was 18 weeks during the nonbreeding season. Individual birds were retrapped as often as 56 times, but 33% were never trapped again, even though 92% were seen after being banded. Many birds learned to avoid recapture although they fed within traps. Of birds seen in 3 or more years, 25% missed from 1 to 5 years before returning.

The oldest bird lived for at least 10 years. Older birds arrived earlier in the fall and departed earlier in the spring. They also were recaptured with decreasing frequency. Birds had a mean life span of 2.1 years and a mean annual survival rate of 62% as shown by a life table. Recapture data gave much shorter estimates than did direct observations.

Analysis of the records of the USFWS banding files showed no evidence of migration—less than 1% were recovered beyond the 10-min block where banded.

#### ACKNOWLEDGMENTS

I am grateful to J. N. Burroughs for statistical treatment of the data, T. Finger for critical review, and M. K. Klimkiewicz of USFWS Migratory Bird and Habitat Research Laboratory for sending the banding record tapes, and to the Missouri Cooperative Fish and Wildlife Unit for partial support.

#### LITERATURE CITED

- BLAKE, C. H. 1949. Tufted Titmouse nesting, seven years. *Bird-Banding* 20:151–152.
- BRACKBILL, H. 1970. Tufted Titmouse breeding behavior. *Auk* 87:522–536.
- BROWNIE, C., D. R. ANDERSON, K. P. BURNHAM, AND D. S. ROBSON. 1979. Statistical inference from band recovery Data-A handbook. U.S.F.W.S. Resour. Publ. 131.
- CAUGHLEY, G. 1977. Analyses of vertebrate populations. John Wiley and Sons. Ltd., London, England.
- CLAPP, R. B., M. K. KLIMKIEWICZ, AND A. G. FUTCHER. 1983. Longevity records of North American birds: Columbidae through Paridae. *J. Field Ornithol.* 54:123–137.
- CONDEE, R. W. 1969. Longevity in Tufted Titmice. *EBBA* [East. Bird Banding Assoc.] *News* 32:231–232.
- . 1978. Notes on wintering Tufted Titmice. *Inl. Bird Banding News* 50:50–56.
- DEEVEY, E. S., JR. 1947. Life tables for natural populations of animals. *Quart. Rev. Biol.* 22:238–314.
- ELDER, W. H. AND D. ZIMMERMAN. 1983. A comparison of recapture versus resighting data in a 15-year study of the survivorship of the Black-capped Chickadee. *J. Field. Ornithol.* 54:138–145.
- FARNER, D. S. 1949. Age groups and longevity in the American Robin: comments, further discussion, and certain revisions. *Wilson Bull.* 61:68–81.

- FRANKS, E. C. 1975. Bias reduction in bird life expectancy estimates. *Bird-Banding* 46: 241-247.
- HELWIG, J. T. AND K. A. COUNCIL. 1979. SAS users guide, 1979 ed., SAS Institute, Raleigh, North Carolina.
- HICKEY, J. J. 1952. Survival studies of banded birds. U.S.F.W.S. Spec. Sci. Rep.-Wildl. 15.
- KENNARD, J. H. 1975. Longevity records of North American birds. *Bird-Banding* 46:55-73.
- KLUJVER, H. N. 1951. The population ecology of the Great Tit, *Parus m. major* L. *Ardea* 39:1-135.
- LASKEY, A. R. 1957. Some Tufted Titmouse life history. *Bird-Banding* 28:135-145.
- LINCOLN, F. C. 1929. Manual for bird banders. USDI Misc. Publ. 58.
- MCCAMEY, F. 1961. The chickadee trap. *Bird-Banding* 32:51-55.
- MIDDLETON, R. J. 1969. Some age records and recoveries from Norristown, PA. EBBA [East. Bird Banding Assoc.] News 32:224-229.
- SHORT, M. 1933. Some Tufted Titmice history. *Bird-Banding* 4:159-160.
- VAN TYNE, J. 1948. Home range and duration of family ties in the Tufted Titmouse. *Wilson Bull.* 60:121.
- WILFORD, G. L. 1977. Notes on the Tufted Titmouse. *Int. Bird Banding News* 49:123-127.
- WOOD, M. 1969. A bird-bander's guide to determination of age and sex of selected species. College of Agriculture, Pennsylvania State Univ., University Park, Pennsylvania.

SCHOOL OF FORESTRY, FISHERIES, AND WILDLIFE, UNIV. MISSOURI-COLUMBIA, 112 STEPHENS HALL, COLUMBIA, MISSOURI 65211. ACCEPTED 23 JUNE 1985.